SYMONS'S
MONTHLY
METEOROLOGICAL MAGAZINE.

CXXX.] JANUARY, 1876. [PRICE FOURPENCE, *or 5s. per ann. post free.*

TEMPERATURE OF THE SOIL.

AMONG the many problems of meteorology which are waiting for observation and discussion, that of the connection between the growth of plants and the temperature of the soil, may fairly claim to be one of the most interesting, and one of practical importance.

In most branches of meteorology the instrumental means of observation, and the accumulated masses of records are in advance of the mental power available for their discussion, but we do not think that that is the case with respect to earth temperature. We therefore devote the present article to a brief narrative of the arrangements proposed, and adopted, for ascertaining the temperature of the soil at slight depths.*

In the *Report of the Committee* [of the Royal Society] *of Physics, including Meteorology, on the objects of scientific inquiry in those sciences*, London, 1840, 8vo,† the only reference to this subject is as follows:—

"The temperature of the soil at different depths is a point of considerable importance. For this purpose excavations should be made in a dry sheltered situation, three, six, and nine feet deep, and lined with brick or earthenware tubes. In the bottom of these excavations earthenware quart bottles may be carefully placed, filled with water, spirit, or brine, and corked. They must be carefully covered with tow or cotton, and drawn up on the days of horary observation, and their temperatures taken by an accurate thermometer."

It is rather remarkable that in Professor Daniell's very instructive essay on climate considered with regard to horticulture,‡ delivered

---

* For notes on the temperature of the earth at great depths see *Meteorological Magazine*, Vol. III., p. 174, *et seq.*

† This roundabout title should have been merely "Instructions for Magnetical and Meteorological Observations."

‡ Elements of Meteorology, by J. F. Daniell, D.C.L., F.R.S., third edition, 1845, Vol. II., p. 218.

before the Royal Horticultural Society, he has considered every part of plants except the roots, and has entirely overlooked the question of the temperature of the soil.

The Meteorological Society of Scotland have devoted some attention to the subject, and on the back of their schedules give (or rather gave in 1865) the following instructions :—

"*Underground Thermometers.* As the germination and health of crops and plants greatly depend on the temperature of the soil—its amount and constancy—the council recommend that observations in this interesting department be made at 9 a.m., by thermometers placed in the earth, their bulbs being sunk to three, twelve, and twenty-two inches [What queer intervals.—ED.]; and the stems above ground protected from the sun's rays, and fitted with sloping tin collars, to prevent rain water being conveyed to the bulbs by the stems or wooden frames. Mention must be made of the geological formation and agricultural condition of the soil in which these thermometers are placed."

M. Renou, in his *Instructions Météorologiques*, Paris 1857, 8vo., writes to the following effect :—"One may observe the temperature of the soil at various depths by means of fixed thermometers, but to observe at a depth of several metres it is necessary to construct on the spot special thermometers, and to plunge them in bore holes lined with iron so closed as to prevent circulation of air. As the temperature varies with the depth, it is necessary to correct the reading of the thermometer for the temperature of its long column. This can be done by employing the indications of other thermometers sunk to less depths, but it is both more convenient and more exact to attach to the thermometer, throughout its entire length, another precisely similar and similarly graduated tube; the difference of the two indications is the correction to be applied to the thermometer in order to take account only of the temperature of its bulb."

"It is much more convenient, especially at great depths, and for the indispensable verification of the instruments, which ought to read easily to one-hundredth of a degree (which can only be done when one degree occupies fully one-third of an inch) to sink in the bore hole a pipe of galvanized iron four inches in diameter, and to put down a thermometer attached to a piece of wood and wrapped in wool, which is easily raised in order to take the readings; a thermometer so mounted changes its reading extremely slowly; immediately after reading, it should be returned down the tube and the top closed. It is necessary to remark that a bore hole should not be used immediately after construction, for the work develops heat, which is not dissipated for some days."

Dr. Jelinek, in his *Anleitung*, 1869, p. 46, refers briefly to the method of Lamont described in the fourth supplement to the annals of Munich Observatory. A similar but rather fuller description is

given in Ebermayer's *Physikalischen Einwirkungen des Waldes*, Aschaffenburg, 1873, p. 12, whence we have copied the annexed engraving. The apparatus consists of four square tubes (like organ

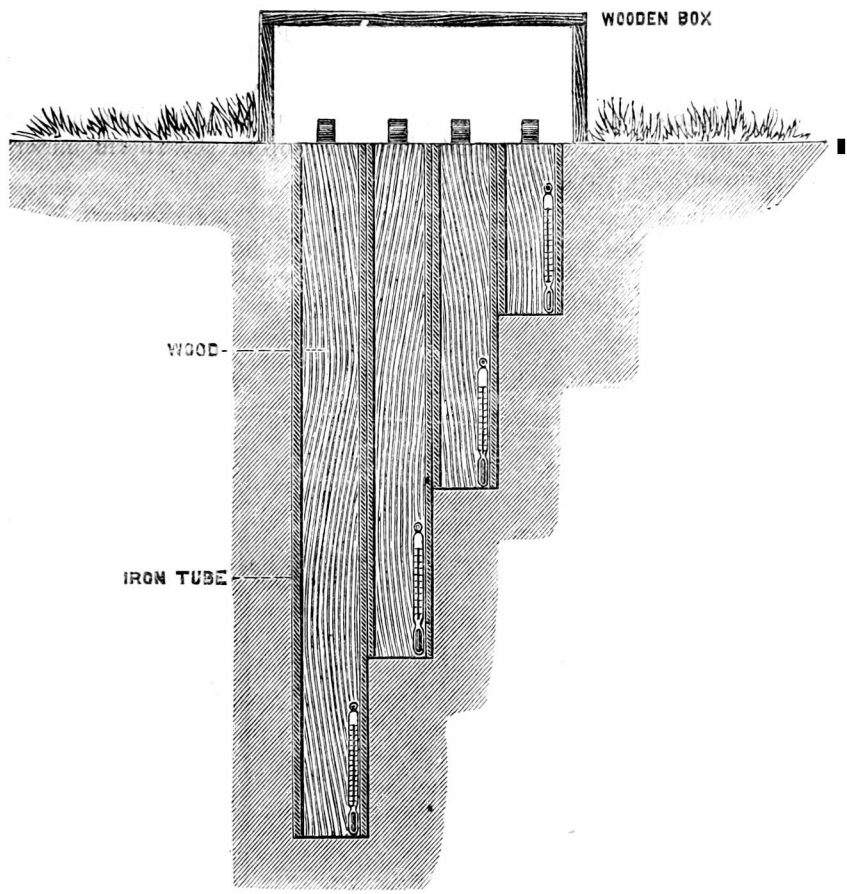

Fig. 1.

pipes), one, two, three, and four feet long, sunk vertically into the earth; fitting loosely into these are four wooden plugs, with knobs at the top and thermometers at the bottom protected by small copper plates. The box or lid over the top is of wood, and can, if desired, be hinged and locked; the thermometers are divided to 0°·1 R, and can, therefore, easily be read to 0°·01 R.

In May last, Professor Wollny, of Munich, described* a modification of Lamont's earth thermometer, designed with the object of avoid-

* Zeitschrift der Osterreichischen Gesellschaft für Meteorologie, Band X., No. 10.

ing the errors caused by the access of water to the inside of Lamont's vertical tubes. Professor Wollny's arrangement is represented in fig. 2 but the essential point is easily explained. He states, very truly, that there is no material better adapted to exclude water than glass, and he therefore makes the tube smaller than Lamont, about one and a half in., diameter, and of strong glass. Unluckily he spoils this good idea by making the bottom of the tube *not of glass*, but of metal cemented to the glass tube—a species of joint which we should not consider likely to be remarkable for durability. A good feature in this form is the collar, of greased cotton wool, just above the top of the thermometer, which prevents the circulation of air.

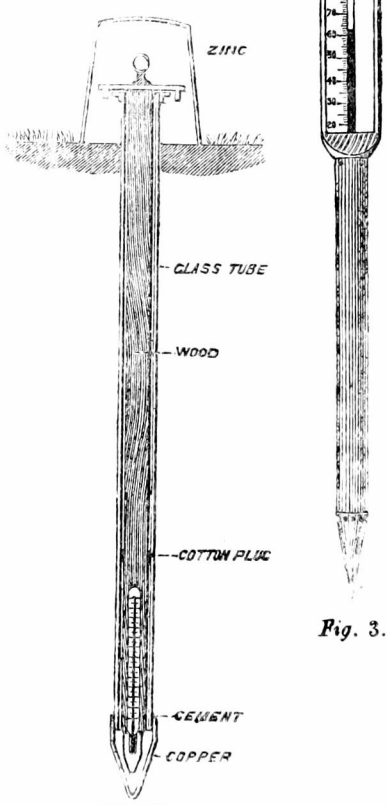

Fig. 2.

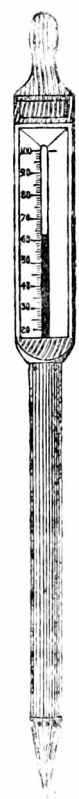

Fig. 3.

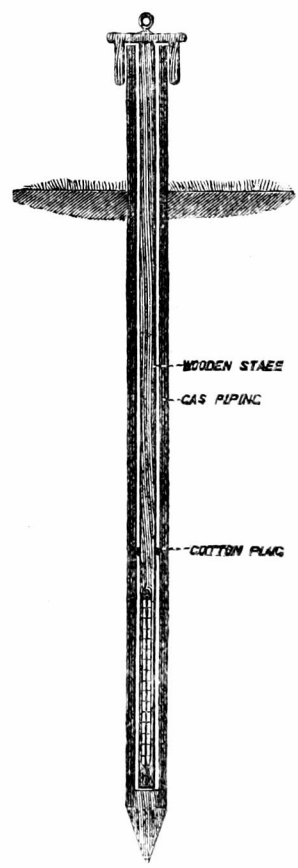

Fig. 4.

There are at present very few sets of instruments for the purpose

of determining earth temperature in use in this country, and the English instruments have not been either durable or easy to read. Fig. 3 represents the most usual form, wich is really that of a hot-bed thermometer. We have had made by Mr. Casella the instrument represented by fig. 4. The tube is very stout iron gas pipe, one inch internal diameter, the lower end closed by welded ing, so as to give great strength and absolute water-tightness; we have adopted Professor Wollny's plan of putting the oil plug and a modification of his cap, making it drop further down so as to prevent indrip. A difference will also be noticed in the mounting of the thermometer bulb, which is in Professor Wollny's surrounded by a perforated metal sheath, while in ours it is as much bedded in non-conducting materials as is possible, with the object of preventing any alteration in temperature during withdrawal and reading. It may be objected to ours that the metal of the tube will convey, to the bulb of the thermometer, temperatures other than that of the soil level with it; certainly glass would be better in that respect, and a stout glass tube, *hermetically sealed* at the bottom, might easily be substituted for our iron one, but it seems doubtful if any temperature acquired by the upper part of the tube would not be so dissipated as to be insensible long before penetrating to the depth of the thermometer bulb, and the liability of the glass to breakage is strongly against its employment.

As regards personal comfort the difference between the use of figs. 3 and fig. 4 is very great; it is very uncomfortable to have to put one's head level with the ground, yet that is the only way of reading the old patterns accurately, unless they be inclined, and if that is done then the instruments must be made longer proportionally to the angle at which they are inclined, and even then the head must be brought within a foot or two of the ground, while nothing of the kind is necessary with the new pattern, the faults of which have not yet shown themselves, though doubtless it has some.

OZONE AT 6,000 FEET ABOVE SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—The amount of ozone in the air at considerable elevations above sea level cannot be so frequently tested as at stations on ordinary levels where observations can be made all the year round, because they are practically uninhabitable for six or eight months of each year. For this reason it is possible that even a few trustworthy observations made at about 6,000 feet above sea level may be worth recording. Last autumn I spent a week at the Rhone Glacier Hotel, Switzerland, and tested for ozone six days consecutively. For the purpose of avoid-

ing the risk of inequality in the papers I used two in the cage each time, and exposed them for twenty-four hours carefully protected from sun and rain. The situation was well up the mountain side amid a wilderness of rocks where cattle could not influence the result by their ordure or breath. There was absolutely no source of air contamination discoverable; the nearest house, the hotel, was half-a-mile distant, the glacier rather more. The weather was faultless for the elevation and the season, no thunderstorms, no rain; the wind blew invariably up the valley towards the glacier from about 3 p.m. till night, caused by the action of a hot sun on the Furka and other mountain masses at its head; in the morning and mid-day it was moderate; direction variable.

For the striking inequality of the results I attempt no explanation; to justify any a very much longer series of observations would be necessary: the large proportion of ozone on two of the days proves that, sometimes at least, it abounds as much at high as at lower levels.

1875.						
Aug. 31	... Two papers exposed together,	24	hours,	each	...	9
Sept. 1	... ,,	,,	,,	,,	...	8
,, 2	,,	,,	,,	,,	...	4
,, 3	... ,,	,,	,,	,,	...	4
,, 4	... ,,	,,	,,	,,	...	6
,, 5	... ,,	,,	,,	,,	...	5

The paper was of unexceptionable quality fresh from Casella's of Holborn: the scale used was that of Negretti and Zambra.

In testing for ozone in Switzerland, even at considerable elevations and far from towns, the quantity found is sometimes surprisingly small; this I have always found could easily be explained by the existence of one or more of those filthy and reeking muck heaps abounding in most of the Swiss villages; they are a nuisance, a source of danger, and a national disgrace.

Your obedient Servant,

THOMAS PALMER, M.D.

Cahir, Co. Tipperary, Ireland.

MOVEMENTS OF CIRRUS.

To the Editor of the Meteorological Magazine.

SIR.—I do not clearly understand Mr. Clement Ley's Table of the directions of Cirrus (ante p. 174). From my own observations, many years since, as well as recently, I have been in the habit of distinguishing between the direction of Cirri and Cirro-cumuli as arranged in the sky (polarized, the term used by Humboldt) and the direction in which they move. I have found the long thread-like streaks of Cirrus

on a fine clear blue sky maintain their direction for hours, their motion being coincident with their arrangement on the sky, I have also found the motion of such bands of Cirri to be at right angles to their lines of polarization. In the latter case the bands have coalesced and the sky has become covered with a more or less uniform sheet of Cirro-Stratus, often characterized by the presence of halos. The distinction I apprehend is important, especially as for many years past Cirri have been associated with electrical conditions of the atmosphere, and still more recently with Auroræ. I am not aware if the heights of Cirri have been determined. So far as regards the magnetic affections of Cirri, Mr. Ley's table gives the greatest number of directions from W.N.W., W., and W.S.W. roughly at right angles to the magnetic meridian. Does Mr. Ley give these directions as of Cirri moving across the magnetic meridian, or do I understand that the bands were arranged (polarized) from W.N.W. to E.S.E.; W. to E.; and W.S.W. to E.N.E.? I have mostly found these clouds—Cirri and Cirro-cumuli—polarized in or near the magnetic meridian; more rarely at right angles to it.—Yours faithfully,

W. R. BIRT.

December 23, 1875.

SNOW MEASUREMENT.

To the Editor of the Meteorological Magazine.

SIR,—I beg to send you the following observations which were carefully taken during the snowy weather at the beginning of this month :—

Date.	Miles of wind in 24 hours.	Average size of flakes.	No. 1 gauge, 5 in. diameter. Depth of funnel. 5 in.	No. 2 gauge, 8 in. diameter. Depth of funnel. 6½ in.	On the ground, average depth of snow.
					in.
Dec. 2	120	large	·280	·295	4½*
,, 4	187	medium	·133	·133	2½†
,, 5	201	large	·112	·113	1½†
,, 6	238	medium	·084	·090	1†
Total	...	..	·609	·631	9½

HOW MELTED.

* Snow taken out, put into a closed vessel, and placed in a warm room.
† By pouring warm water into funnel.

No. 1 and 2 gauges are 2 feet above the ground. These totals being corrected (see page 19 "Rain: How, When, Where, Why it is Measured,") makes No. 1 gauge yield at the ground level ·655, and

No. 2, ·678 for 9½ inches of snow; this is then equivalent to a rate of 1 inch of rainfall for every 14 to 14·5 inches of snow. In your instructions in the "British Rainfall," you advise observers to take one-twelfth as the equivalent of water. I had also the following gauges, placed in a tolerably exposed position 65 feet above the ground, they gave similar results (allowing of course for difference of height, which is not added).—

No. 3 gauge, 8 in. diameter, Snowdon pattern; depth of funnel 12¾ in.; snow melted ·554 in.
No. 4 gauge, 8 in. diameter, Glaisher pattern; depth of funnel 6½ in.; snow melted ·562 in.
No. 5 gauge, 5 in. diameter (copper); depth of funnel 4¼ in.; snow melted ·550 in.

I should like to know if any similar observations have been taken lately, and if so, with what results?

Examination of Thermometers.

I am glad to see by a certificate of a fork-bulb minimum (by Casella) which I have just received from Kew Observatory, that the scale-readings are in future to be taken below 32° (for which there is no extra charge); often there is no error at the freezing point, when a few degrees lower a correction should be made, take the following index errors of the above thermometer as an example.

At 12°	+ 0·3	At 52°	— 0·0
,, 22°	+ 0·4	,, 62°	— 0·0
,, 32°	— 0·0	,, 72°	— 0·1
,, 42°	— 0·1		

Yours faithfully, KAUFMANN J. MARKS.

11, *Warrington Crescent, W., Dec. 24th*, 1875.

REVIEWS.

Abstracts and Results of Magnetical and Meteorological Observations at the Magnetic Observatory, Toronto, Canada, from 1841 to 1871 inclusive. Toronto: Copp, Clark and Co., 1875. 8vo.

Of all the British Magnetical Observatories that at Toronto has been the most successful. That it has been fortunate in its directors is at once shown by the names of Riddel, Younghusband, Lefroy, and from 1855 to the present time Kingston; the site chosen for it was a good one, the continuity of the observations has been secured, and from time to time useful results have been published. In the matter of

publication we have two complaints to make. First, it is to be regretted that the works are not uniform in size. The first three volumes, published under the superintendence of General Sabine are quarto, then we have two thin volumes published in 1864 which are small quarto, and the present book is an octavo. Our second regret is the omission of a list of the publications of the establishment (such as we are glad to see in every work issued by the Meteorological Committee); a list of this kind occupies little space, and is of great service, as showing at once what information has been published. The following queerly worded paragraph in the introduction to the present work leaves us in uncertainty as to what has been issued.

"As details regarding the several instruments and their adjustments are described at length in the three first volumes (1840 to 1848*), and in the three volumes 1853–62, they are omitted here."

In the hope that it may lead to the removal of the uncertainty now hanging over the Toronto publications, and also that other Directors may be induced to follow the example of the Meteorological Committee, we give the following list of the publications connected with Toronto Observatory, which we possess, and we hope that Prof. Kingston will enable us to perfect it in a subsequent number.

Sabine, Col. E., R.A. Observations on a Remarkable Magnetic Disturbance at Toronto, Sept. 26th, 1841 [Excerpt from British Association Report, 1841]. 1842; 4to.

Sabine, Lieut.-Col. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. I. (1840–42). London, 1845. 4to.

Sabine, Lieut.-Col. E., R.A. Report on the Meteorology of Toronto. [Excerpt from British Association Report, 1844]. London, 1845. 8vo.

Sabine, Col. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. II. (1843–45). London, 1853. 4to.

Sabine, Col. E., R.A. On the Periodic and Non-periodic Variations of the Temperature at Toronto, from 1841 to 1852 inclusive. [Excerpt from Phil. Trans., 1852]. London, 1853. 4to.

Sabine, Col. E., R.A. On the Influence of the Moon on the Magnetic declination at Toronto [Excerpt from Phil. Trans.], 1853; 4to.

Sabine, Major-Gen. E., R.A. Observations made at the Magnetical and Meteorological Observatory at Toronto, in Canada. Vol. III. (1846–48, with abstract to 1855). London, 1857. 4to.

Sabine, Col. E., R.A. On the Lunar Diurnal Variation at Toronto [Excerpt from Phil. Trans., 1856]. 1857; 4to.

Kingston, Prof. G. T. Results of Meteorological Observations made at the Magnetical Observatory, Toronto, Canada West, 1860–62 inclusive. Toronto, 1864. Small 4to.

Kingston, Prof. G. T. Abstracts of Meteorological Observations made at the Magnetical Observatory, Toronto, Canada West, 1854 to 1859 inclusive. Toronto, 1864. Small 4to.

---

* Referring probably to General Sabine's three large quarto volumes.

Kingston, G. T. Instructions to Meteorological Observers, in correspondence with the Magnetic Observatory, Toronto. 8vo. 1871.

Kingston, G. T. General Meteorological Register for 1871. 8vo.

Kingston, G. T. General Meteorological Register for 1872. 8vo.

Kingston, G. T. General Monthly Meteorological Register for 1873. Toronto.

Kingston, G. T. Second Report of the Meteorological Office of the Dominion of Canada. Ottawa, 1873. 8vo.

Kingston, G. T. General Meteorological Register for 1873. 8vo. Toronto, 1874.

Kingston, G. T. Third Report of the Meteorological Office of the Dominion of Canada. Ottawa, 1874. 8vo.

Kingston, G. T. General Meteorological Register for 1874. 8vo.

Kingston, G. T. Reports on the Meteorological, Magnetical, and other Observatories of the Dominion of Canada for the year 1874. 1875. 8vo.

Kingston, Prof. G. T. Abstracts and Results of Magnetical and Meteorological Observations at the Magnetic Observatory, Toronto, Canada, from 1841 to 1871 inclusive. Toronto, 1875. 8vo.

We now pass to the results, and the first which we notice is so startling that we reproduce the paragraph :—

During and prior to the time when the observations were made, on which General Sabine based his conclusions (1841-52), the mean temperature of January exceeded very decidedly the mean of February in other parts of North America, as well as at Toronto. Testimony to this effect is given by Dove, who describes the isothermal lines as moving southwards from January to February. Observations of subsequent years, however, at other places, even more than at Toronto, show a preponderance in the temperature of February, thus :—

			deg.
At Isle Jesus (near Montreal)	1853-62,	February was warmer than January by	3·4
Quebec	1860-67,	,, ,, ,,	3·6
St. John, New Brunswick...	1861-68,	,, ,, ,,	3·6
Halifax ...	1867-69,	,, ,, ,,	2·3
Stratford, Ontario	1861-69,	,, ,, ,,	1·8
Toronto	1859-68,	,, ,, ,,	1·9

That the change in the time when the greatest cold occurs in Toronto has been a progressive change, is shown by comparing the means of January and February in groups of five years :—

		deg.			deg.
1841-45,	Jan. warmer than Feb. by	2·6	1856-60,	Jan. colder than Feb. by	0·3
1846-50,	,, ,, ,,	2·6	1861-65,	,, ,, ,,	1·5
1851-55,	,, ,, ,,	0·9	1866-69,	,, ,, ,,	2·1

If the alteration here implied really exists, it is a most important fact. We have, therefore, devoted some care to its examination, especially as Prof. Kingston immediately drops the subject. The first thing is to get at all the precise facts which have yielded the above mean values: they are given in the following table, which is formed from Table IV. of the work under notice, and completed from Prof. Kingston's General Meteorological Registers.

Difference between the mean temperature of January and February in each year, from 1841 to 1871, both inclusive.

Year.	Amount. deg.	Year.	Amount. deg.	Year.	Amount. deg.	Year.	Amount. deg.
1841	— 3·2	1851	+ 2·1	1861	+ 6·4	1871	+3·0
2	— 1·0	2	+ 5·0	2	+ 0·9	2	—1·7
3	—14·2	3	+ 1·3	3	— 5·4	3	+3·8
4	+ 5·8	4	— 2·3	4	+ 1·5	1874	—2·0
5	— 0·5	5	—10·3	5	+ 4·7		
6	— 6·3	6	— 0·2	6	+ 1·8		
7	— 1·8	7	+16·0	7	+11·3		
8	— 2·1	8	—12·9	8	— 1·8		
9	+ 1·0	9	— 0·2	9	— 2·7		
1850	— 3·7	1860	— 0·3	1870	— 2·9		

— denotes February colder than January.

The first thing which strikes one in this table is the magnitude of the difference in some years. Evidently the low mean temperature of February, 1843, (14°·2 below that of January*) is the cause of nearly half the deficiency found in the first ten years, and similarly the excess in the decade (1861–70) is considerably augmented by the excess of 11°·3 in 1867. Still the fact that the plus signs denoting excess of February temperature above that of January are only 2 in the first decade, while there are 4 in the second, and 6 in the third, certainly indicates something more than an accidental disturbance due to a few exceptional incidents. The thorough examination of this subject would be altogether unsuited to a mere review, but we believe that the question is worthy of it, for if it be possible to trace the effect of the clearance of vast woods, and the cultivation of previously waste tracts, surely America is the place where this will be most easily done, for, contemporaneously with its great material progress, very fairly accurate and long continued series of observations have been made and published.

Prof. Kingston appears to share with some other meteorologists a love for means far greater than for extremes. We believe that extremes are of at least equal importance, and have, therefore, hunted out the following facts.

	Temperatnre in Shade. deg.		Pressure at 342 ft. + Sea Level. in.		Yearly Rainfall (Rain & Snow). in.	
Highest	99·2	Aug., 1854	30·940	Jan., 1866	46·19	1870
Mean...	44·2		29·621		35·62	
Lowest.	—25·4	Feb. 1855	28·166	Jan., 1870	26·18	1848
Range..	124·6		2·774			

The greatest fall of rain in one day was in September, 1843, viz., 3·46 in. Useful tables of the frequency of auroræ, of thunderstorms, hail, fog, &c., are also given, as well as daily meteorological abstracts for the years 1863 to 1871 inclusive.

---

* This prevailed over the whole of N. America, the greatest difference being in the North West; at Fort Snelling, Minessota (Lat. 44° 53′, Long 93° 10′ W.) the mean temp. of February was 18°·7 below that of January.

Results of Observations in Meteorology, Terrestrial Magnetism, &c. taken at the Melbourne Observatory, during the year 1872 *; with abstracts from Meteorological Observations at various localities in Victoria.* By R. L. J. ELLERY, Government Astronomer. Vol. I. Melbourne : John Ferres. (No date).

GREAT was our surprise at seeing "Vol. I." on the cover of this work, as we knew that Melbourne observations extend back to 1840. The first few sentences of the preface cleared up the mystery, and are so terse and to the point that we reprint them.

"The first results of Meteorological and Magnetical Observations made at the Melbourne Observatory were published in 1859 in a volume entitled 'Results of the Magnetical, Nautical, and Meteorological Observations, Melbourne,' and in 1863 in a volume entitled 'Meteorological and Nautical Observations, 1859 to 1862, Melbourne.' Since the issue of the latter volume there was no publication of the Meteorological or other Physical Observations made here until January, 1872, when the 'Monthly Record of the Observations made at the Melbourne Observatory in Meteorology, Terrestrial Magnetism, &c.,' was first issued.

"The present volume is simply an annual issue of these records, to which is appended a series of tables, abstracts and means, deduced from the year's observations.

"It is hoped that the present arrangement of the results of the Melbourne Observations will be found of value to the scientific enquirer as well as to the general public ; for while they have been condensed as far as appeared consistent with scientific value, the methods of reduction, as well as carefully computed tables of averages and means, are added, so as to give to the meteorologist all data—short of the record of the observations themselves—from which to make deductions respecting the climate of the colony of Victoria, or from which to obtain information relative to various meteorological and physical conditions ruling in this portion of Australia.

"The observations from which the following results have been obtained have been for the most part made at this Observatory, under the charge of Mr. C. Moerlin, second assistant ; while those from other parts of the colony have been made by the gentlemen whose names appear in the abstracts pertaining to the several localities."

We think that Mr. Ellery might have added a paragraph respecting the Flagstaff Observatory, and Dr. Neumayer's publications connected therewith. Possibly if we possessed the two works mentioned by Mr. Ellery we might find in them that which, even in that case, should still have been reprinted in the inaugural volume of what, we hope, will be a long series of annual reports.

We believe that the observations at the Flagstaff Observatory extended from 1858 to 1863, inclusive, and that the publications connected with that establishment were :—

Neumayer, G. Results of the Meteorological Observations taken in the Colony of Victoria during the years 1859-62. 4to. 1864.

Neumayer, G. Results of the Nautical Observations collected and discussed at the Nautical Observatory, Melbourne, 1858-62. 4to. 1864.

Neumayer, G. Discusssion of the Magnetical and Meteorological Observations made at the Flagstaff Observatory, Melbourne, 1858-63. 4to. 1867.

Dr. Neumayer, in the preface to the last-mentioned work, is not accurate in his reference to his own publications, which he refers to as "Results, Vol. I." and "Results, Vol. II.," although we believe no such numbers are placed upon the books. We are not *certain*, not

having seen them. This, however, is nothing compared with the unertainty in which Mr. Ellery leaves his readers, through the absence of about one page of letter-press and, perhaps, half-a-dozen pages of tables. We do not ask that he should copy the Greenwich plan, and *every year* print a full history of his observatory and of all its instruments; but we do consider that to render the work complete, the first volume of the series should have contained a brief history of the Observatory, with a view of it, and a ground plan, and that there should have been given tables of the principal results used as standards of comparison. For instance, on page 136 there is a very useful and valuable table showing the difference of the principal elements in 1872 from the average of previous years; but there is nothing to show where the observations (whence these averages have been computed) were made, or what or when changes in the modes of observation have been introduced.

We are glad to conclude by congratulating Mr. Ellery on all the rest of the volume, on the good distribution of his country stations, and the completeness of his abstracts, especially those of heavy rainfall, and, though last by no means least, upon the clearly printed map of the stations.

SUPPLEMENTARY TABLE OF RAINFALL IN DEC., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	1·33	Gainford	1·92
Hailsham	1·46	Shap	7·14
Strathfield Turgiss	1·08	Llanfrechfa	3·50
Addington Manor	1·37	Castle Malgwyn	3·83
Oxford	·86	Heyope	2·60
Cambridge	1·01	Melrose	2·07
Sheering	1·20	Cessnock, Glasgow	5·03
Ipswich	1·29	Gruinart	...
Diss	1·97	Keith	2·73
Swaffham	1·73	Strathconan	5·54
Compton Bassett	1·07	Springfield, Tain	2·05
Hessary Tor, Dartmoor	4·11	Skibbereen	2·73
Teignmouth	1·25	Fermoy	3·28
Torrington	2·45	Kilrush	2·97
Trevarrick, St. Austell	2·46	Kilkenny	1·73
Taunton	·88	Kilsallaghan	1·75
Cheadle	1·66	Twyford, Athlone	2·54
Ashby de la Zouch	1·55	Ballinasloe	3·04
Coston, Melton Mowbray	1·94	Kylemore	9·11
Bucknall	·99	Bangor	4·24
Mansfield	1·54	Carrick on Shannon	1·96
Walton, Liverpool	1·06	Warrenpoint	3·05
Broughton-in-Furness	4·00	Bushmills	2·61
Stanley, Wakefield	·79		

DECEMBER, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	·94	— ·56	·26	2	15	54·8	22	23·2	4	10	12
II.		Maidstone (Linton Park)	2·30	+ ·47	·95	6	14	54·0	22	20·0	7	11	...
,,		Selborne (The Wakes)	1·61	— 1·14	·39	21	11	51·0	24	18·0	4	12	13
III.		Hitchen	1·04	— ·27	·41	2	13	51·0	21†	19·0	5	14	...
,,		Banbury	1·12	— ·55	·26	2	14	53·0	21†	22·0	6	14	..
IV.		Bury St. Edmunds (Culford)	1·84	+ ·35	·40	4	17	55·0	22	16·0	3	12	14
V.		Bridport	1·28	— 2·09	·50	2	9	54·0	22	18·0	4	...	...
,,		Barnstaple	2·02	— 1·10	·43	21	15	56·0	22	22·0	6	...	...
,,		Bodmin	2·79	— 2·45	·88	18	18	52·0	22	23·0	18	8	12
VI.		Cirencester	1·64	— ·65	·46	31	8	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	1·03	— ·65	·46	31	9	52·0	21	22·0	6,7	12	15
,,		Tenbury (Orleton)	1·63	— ·83	·53	31	14	55·0	22	24·0	6	14	16
VII.		Leicester (Belmont Villas)	1·33	...	·29	2	13	54·8	22	24·8	6	10	..
,,		Boston	1·20	— ·29	·32	5	13	56·0	21	27·0	8	13	...
,,		Grimsby (Killingholme)	1·31	...	·19	4	18	54·0	21	29·0	6	5	...
VIII.		Manchester	..	...	...	...	...	...	...	...	...	...	...
IX.		York	89	...	·17	4	12	...	...	...	...	...	..
,,		Skipton (Arncliffe)	4·79	+ ·24	1·11	21	21	48·0	27	15·0	14	14	...
X.		North Shields	1·44	— ·76	·36	2	18	52·5	21	27·8	16	9	17
,,		Borrowdale (Seathwaite)	13·93	— 3·02	3·19	20	17	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	2·03	— ·57	·57	20	15	...	...	...	...	...	...
,,		Haverfordwest	3·93	— ·90	1·50	18	9	53·0	21	19·0	5	14	18
,,		Rhayader (Cefnfaes)	...	...	...	..	...	...	...	...	...	...	...
,,		Llandudno	1·41	— ·79	·61	21	7	58·0	20	31·8	6,7‡	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	3·06	— ·96	·85	21	16	51·6	22	22·8	6	13	13
,,		Hawick (Silverbut Hall)	2·64	...	1·15	21	12	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	2·50	...	·39	21	20	51·2	21	20·0	8	11	13
XV.		Castle Toward	...	...	...	...	...	...	...	...	...	...	..
XVI.		Leven (Nookton)	2·57	— ·21	·50	21	16	51·0	20	25·0	15	10	19
,,		Stirling (Deanston)	...	...	...	...	...	..	...	...	..	...	...
,,		Grandtully	4·00	...	·91	23	12	...	...	..	...	...	...
XVII.		Braemar	4·39	+ ·62	·88	21	15	48·2	26	11·8	4	11	21
,,		Aberdeen	1·92	...	·37	18	20	52·2	24	25·4	5	10	22
XVIII		Loch Broom	...	...	..	...	...	...	...	...	...	...	...
,,		Portree	8·56	— 7·07	1·06	24	27	...	...	...	...	...	...
,,		Inverness (Culloden)	2·33	+ ·40	·46	24	15	51·6	31	19·2	6	9	20
XIX.		Helmsdale	2·69	...	·72	25	22	...	...	...	...	...	...
,,		Sandwick	3·36	— ·61	·50	23	23	54·1	20	28·0	7	9	14
XX.	IRELAND.	Caherciveen Darrynane Abbey	2·97	...	·76	30	12	...	...	...	...	...	...
,,		Cork	2·28	...	·40	18*	14	...	...	...	...	...	...
,,		Waterford	2·03	— 2·39	·62	21	12	55·0	20	26·0	9	12	...
,,		Killaloe	3·93	+ ·44	·60	21	13	...	...	...	...	...	...
XXI.		Portarlington	1·76	— 1·43	·45	18	18	54·0	21	22·0	5	13	...
,,		Monkstown, Dublin	1·38	— 1·24	·33	21	11	...	...	...	...	...	...
XXII.		Galway	2·89	...	·75	21	14	56·0	22	18·0	9	13	...
,,		Ballyshannon	1·93	...	·45	21	13	...	...	...	...	...	...
XXIII		Waringstown	1·61	...	·61	17	15	55·0	21	19·0	4,5	16	21
,,		Edenfel (Omagh)	2·50	...	·65	21	15	50·0	21	17·0	7	18	...

* And 31. † 22. ‡ 8.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON DECEMBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail: S for Snow.

ENGLAND.

LINTON.—The snow which had commenced the last week in November received great additions on 2nd, 3rd, 5th, and 6th of December, and was in places drifted to a great depth, but a slow thaw taking place on 10th and 11th, it gradually disappeared with less flood than expected. High wind on 22nd; dense fogs on 16th, 18th, and 26th; bar. generally high during the month, and, strange to say, the ther. only once fell below freezing point after the 11th. The month may be described as the first ten days wintry, after that time mild, the last sixteen days particularly so for December.

SELBORNE.—The first half of the month remarkably cold, the second half unusually warm; the prevailing winds in the early part, N.E., passing round by N.W. and W. to S.W., the latter half; S daily during first week; fog almost daily from 8th to 20th inclusive; high wind on 22nd; cloudy from 25th to 29th inclusive.

CULFORD.—S almost daily to the 9th, fine from 11th to 20th, mild weather after the tenth day; mean. temp. of the month, 37°·7; easterly winds prevailing during twelve days.

BODMIN.—Mean. temp., 41°·7; R 2·16 in. below the average (26 years).

SHIFNAL.—The wind up to the 15th was N. and N.W., then S. and S.W. (with two exceptions) till the close. Although dry, it was cold beyond the average for the first ten days; the max. ther. never exceeded 36°·0, and the min. was below 32° each night; 3 in. of S fell on the 6th; on 21st a sudden rise in temp. took place, followed by a heavy gale from S.W. at night. From that day it continued mild, the vast display of holly-berries alone reminding one that it was winter.

ORLETON.—The weather throughout the month was cloudy and gloomy, and the sun was rarely visible. The air was cold with frosts almost every day till the 16th, when the wind changed to the S., and the remainder of the month was warm. The mean. temp. was a trifle higher than the average for the month. The wind was violent on 21st, 22nd, 23rd, and 31st. A heavy fall of R, succeeded by S, set in soon after 10 p.m. on the night of 31st; with this exception the falls of R were light.

LEICESTER.—S fell occasionally during the first week; latter half of the month very mild for the season; many roses in bloom in sheltered places on Christmas Day.

BOSTON.—A fine, mild, dry month, enabling the farmers to complete their wheat sowing, delayed by the rains of October and November. The rainfall of the month below the average.

GRIMSBY.—Mild month, the latter part especially so; some very pleasant days during the last week.

NORTH SHIELDS.—Aurora on 8th; L on 21st; S in the early part of the month, but fine during the last week.

SEATHWAITE.—R 3 in. below the average, though there were ten days on which the fall exceeded ·50 in., six on which more than 1·00 fell, and on one day (the 21st) 3·19 was measured.

WALES.

HAVERFORDWEST.—On the whole, a dry and cold month, the first 17 days very cold and frosty, then came a very wet stormy period of five days' duration; cloudy, misty, and mild from the 26th to 31st.

LLANDUDNO.—Dull and cold the first week, but very fine, dry, and mild the remainder of the month. Heavy gale on 21st.

SCOTLAND.

DUMFRIES.—Continuous frost up to the 12th, remainder of the month ver moist, with occasional heavy gales; rainfall ·40 greater than last December mean. temp. unusually high (38·8); H on 21st, and gale on 22nd.

SILVERBUT HALL, HAWICK.—Frosty at nights from 1st to 9th; Teviot in high flood on 21st, on which day 1·15 of R fell; winds changed often on 3rd and up to the 9th. The year departed in a storm of wind and R.

ANNANHILL.—From 1st to 9th cold, easterly winds, with low temperature and much frost, accompanied by a high bar., after which winds changed to westerly and S.W., and the temp. rose again, bar. falling with slight variations to the end of the month. The period of easterly winds was remarkable by the entire absence of ozone; after then it was well developed. Great storm on 23rd and 24th, W.S.W. gale, 70 miles an hour. There were also gales on 20th, 21st, 22nd, and 31st; T, L, H and R, on 22nd; temp. 1·95 less than November; much S fell during the first part of the month; death rate for the year 31 per 1000, total number of deaths 769, average mortality 603.

BRAEMAR.—L 22nd and 23rd.

ABERBEEN.—L 10 to 11 p.m. on 22nd, and at 8 p.m. on 23rd. Early part of the month cold, with S which never lay to the depth of 2 in.; the latter portion of the month rather mild, with frequent high winds.

PORTREE.—Wet and squally month; S and H 7th, 8th, and 11th; gale from W.S.W. to N.W. on 22nd, 23rd, and 24th; L on 20th and 21st at night; T and L, at night, on 22nd and 23rd; S, H, and sleet showers on 2nd, 3rd, and 4th. The rainfall greatly below the average.

SANDWICK.—The first part of December was generally frosty and calm, but after the 20th it was frequently stormy, with R and sleet. T and L on 22nd and 24th, and L on 23rd.

IRELAND.

DARRYNANE.—Fine, with N.E. winds and frost to the 11th; moderate gale from S.W. on the 12th, increasing to a heavy gale from the same point on the 14th; rest of month moderate westerly winds and variable weather; moderate gale from S.W. on night of 20th and 21st; and very heavy gale from N.W. on 22nd.

WATERFORD.—T, L, and H on 22nd.

MONKSTOWN.—Month commenced with unusual severity; frost and S for the first ten days; the Dublin mountains being white for more than a fortnight. There were several days' skating, which is very unusual here in December.

GALWAY.—L and T on the early mornings of 22nd and 23rd.

BALLYSHANNON.—The first part of the month was frosty, and up to the 17th almost entirely free from R; the latter part was wet and stormy, with much L and some very heavy H showers.

WARINGSTOWN.—Hard frost until the 11th, then a nice dry thaw, without R, till the 17th; the remainder of the month mild and fine, with occasional slight showers at night.

EDENFELL, OMAGH.—First half of the month fine and dry, with frost sufficently intense to freeze the lakes and rivers. Remainder of the month mild, wet, and unsettled.

END OF VOL. X.